

RUPTURE OF THE JOINT CAPSULE AND EXTENSIVE CONTUSIONS AS CONTRA-INDICATIONS TO IMMEDIATE SUTURING OF FRACTURE OF THE PATELLA.

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IN discussing the subject of fracture of the patella in a former article by the writer, the following language was made use of:¹

"The operation, in the hands of skilful and thoroughly competent surgeons, is destined to become shorn of all its dangers, both imaginary and real, as an immediate method of treatment; it will, without doubt, in the not very far future, supplant the uncertain and tedious means at the disposal of our forefathers, and in vogue, to a great extent, at the present day." It is with the view of modifying, to some extent, the views therein expressed, that I have brought the matter forward again, further experience in the treatment of fracture of this bone having served to convince me that arthrotomy and suture as an immediate method of treatment, in some cases at least, is fraught with considerable peril, both to the life and limb of the patient.

During the past eight years I have performed the operation of suturing fracture of the patella 13 times. My first case perished from carbolic acid poisoning, the patient, as was ascertained by the post-mortem examination, being the subject of chronic diffused nephritis. The fracture was complicated by a hæmarthrosis, and the operation of arthrotomy was undertaken for the purpose of securing the injured vessel, as a

¹ANNALS OF SURGERY, vol. v., No. 6, June, 1887, p. 518.

final resort, after failure of the usual measures of treatment, and recurrence of the hæmorrhage. Fortunately for my future efforts in this direction, the death was due to an over-zealous application of the antiseptic principle, rather than from the failure of a well and judiciously applied aseptic effort, else I should not have ventured to repeat what I believe to be an operation entirely justifiable and proper, under proper conditions and within certain limits.

Of these 13 fractures of the patella treated by suturing, 2 occurred simultaneously in the same individual, and resulted from a fall from an elevated railroad structure. The right patella was broken into four, and the left into three fragments. The ambulance surgeon had applied a bandage to both knees, previous to bringing him into the hospital, and these were permitted to remain until I saw the patient, seven hours later. At this time there was no effusion into either of the joints, and both patellæ were wired at once. In spite of the most rigid asepsis, extensive suppuration took place in both thighs, the joints which had been accurately closed by a separate suture, and which closed at once, being the last to become infected. Extensive incisions, which gave vent to broken-down blood clot and sloughing cellular tissue, as well as considerable pus, were made, and it was only after a prolonged and dangerous suppurative process, during which the patient was placed in the greatest possible peril, that he was saved from what seemed a possibility of double amputation and perhaps death. The region in and above the internal condyles was primarily, but the joints finally became infected. He left the hospital with fair motion in one joint, and almost complete fibrous ankylosis in the other. One especially well-marked feature in this case was the occurrence of extensive ecchymosis of both thighs, which became plainly visible about the seventh day following the accident, which extended well toward the brim of the pelvis and upon the buttocks.

A second case, that of a painter, who fell from a step ladder, followed an almost precisely similar course. This injury also resulted from the application of direct violence. The primary dressing applied by the ambulance surgeon, consisting of a back splint and rather firm bandage, was permitted to

remain in place for several hours, at the end of which time they were removed, when it was observed that a remarkably slight amount of effusion was present in the joint. Arthrotomy and suture were performed, but in spite of every precaution extensive suppuration took place, and it was only after persistent opening up and drainage of the structures of the thigh that the case was finally brought to a safe termination.

The third case was that of a man who had received a smart blow upon the anterior surface of the knee-joint from the kick of a vicious animal. No bandage was applied to this case, but a very slight amount of effusion was observed to have taken place in the knee-joint. Arthrotomy and suture were performed eight hours later. Suppuration occurred along the vastus internus muscle, and early and free incision only sufficed to save the limb.

The joint in this case did not become invaded until comparatively late, the inflammation and suppuration in its incipency being purely extra-articular, and in some respects it fared much better than the others, yet it became a source of much anxiety to me until it was finally dismissed with a useful limb.

A fourth case, that of a very muscular laborer, received the injury in the classical manner, *i. e.*, by muscular violence. During the night following the accident the effusion, which had been at first considerable, disappeared almost entirely under the influence of pressure exerted by a Martin's elastic bandage. The joint was opened the next day, and the fragments sutured by a silk-worm gut suture. On the third day a rise of temperature indicated some disturbance of the injured parts. This was found to consist in extensive suppuration of the thigh which necessitated the institution of prompt measures of relief. Repeated incisions and thorough drainage were followed by improvement in the patient's condition, and in final cure.

Here, as in the preceding cases, the joint itself was the last to become infected; the thigh, particularly upon its inner aspect, was the site of extensive ecchymosis, as it was at this point likewise that the suppurative process had its origin and expended its greatest force.

A fifth case, that of a horse-shoer, was the result of direct

violence, the patient having received the calk of a horse's shoe directly upon the anterior surface of the right patella by a kick of the animal. The fracture was oblique, and from this circumstance the fractured bone was not wired, but catgut sutures were applied to the capsule to approximate the edges of the latter, as well as to steady the fragments. Infection took place within the joint itself, and the latter was re-opened, irrigated and treated by tamponing with iodoform gauze. Following this course of treatment the case finally came to a satisfactory conclusion, although an almost completely ankylosed joint resulted.

In this case no infection of the thigh took place, although the joint infection was complete and decided. This, however, was due, not to any want of care in the operation, nor to a failure to properly appreciate the conditions present, but rather to the fact that infection had occurred before he fell into the surgeon's hands. In pre-antiseptic times this limb would have been condemned for amputation at once.

To offset these unfortunate experiences I have to add three cases in which the primary suture was applied in simple uncomplicated fractures of the patella with most brilliant success. In two of these the effusion was copious and rapid, and the provisional dressing applied by the ambulance surgeon was removed within the first few hours after entering the hospital, owing to the agonizing pain incident to the increasing pressure of the bandage as the swelling went on. In a third case, treated in private practice, there had likewise been considerable effusion immediately following the accident, but this had in a measure subsided under evaporating lotions when I was requested to see him by his family physician on the fifth day. In all of these cases an uncomplicated and uneventful course of healing followed arthrotomy and the application of the suture to the fragments. The injuries were the result of muscular violence, and there was a marked absence of contusion and ecchymosis in the limbs.

The following case still further illustrates the fact that infection, occurring in the neighborhood of the joint itself, need not necessarily involve the deep structures of the thigh, particularly in the plane of muscular tissue which constitutes the vasti:

An adult woman was brought into the hospital with a rupture of the ligamentous connecting band between the fragments of a patella which had been originally fractured more than twenty years before. A considerable amount of effusion had occurred within the joint, which did not disappear upon the application of a firm bandage. On the fifth day arthrotomy and suture of the fragments were done. A plate of hard rubber was placed upon the anterior surface of the patella, after suturing the operation wound, and the ends of the wire suture twisted over this. A slight point of ulceration occurred beneath this plate of hard rubber, which became infected, and the subcutaneous cellular tissue about the joint became the site of extensive suppuration. The deeper planes and intermuscular spaces of the thigh, however, escaped entirely, and at no time was there any considerable elevation of temperature nor the grave constitutional disturbances which was such a pronounced feature in the cases included in the first series.

As illustrative of the comparatively slight danger of opening the joint and securing the fragments by suture in cases in which a sufficient time has been allowed to elapse to bring the latter within the category of secondary operations, the following is reported:

An ex-cavalryman had been discharged from the United States service on account of a fracture of the patella and the functional disability resulting therefrom. An accident, which produced a rupture of the ligamentous band of union between the fragments, occurred fourteen days prior to the time when he came under my observation. But very slight swelling had been present from the beginning, and a firm bandage had been applied continuously without discomfort. Upon the sixteenth day following the infliction of the injury the fragments were brought together, after opening the joint and dissecting away the old fibrous connecting band. A perfectly aseptic course followed, and the patient was dismissed with a useful limb.

In three subsequent cases of secondary suture, done at periods varying from six months to two years following the injury, in which the operation was undertaken for functional disability due to the existence of ligamentous union following fracture of the patella, equally brilliant results followed.

The following case previously reported² shows the importance of attempting to secure thorough antisepsis from the very beginning:

An insane woman jumped from a second-story window to the sidewalk, striking her right knee-joint and suffering a compound fracture of the patella. She was cared for immediately, the wound being thoroughly irrigated and protected by an antiseptic dressing. I applied the suture at once and no infection followed, although the upper fragment subsequently became necrosed, owing to the violence which it had sustained, and was removed. The patient was discharged from the hospital with a useful limb, the movements of which subsequently became normal in every respect. In this case, although the injury resulted from direct violence, there were no contusions other than that directly upon the anterior surface of the patella, the surrounding parts having entirely escaped.

In reviewing these cases, one is struck by these points: 1. The persistency with which the cases which had been exposed to great violence developed infectious inflammatory complications. 2. The striking fact that in these cases the primary points of infection reached rather to the deep muscular structure of the thigh than to the knee-joint itself, and this latter only became infected subsequently. 3. The immunity of the structures of the thigh from infection when these were uninjured, even in the case in which direct infection of the joint itself occurred, and suppuration of the latter followed. 4. The fact that when excessive traumatism and infection were both absent, a remarkably rapid cure followed, with a perfectly useful limb. 5. The perfectly safe course which those cases pursued which were sutured as a secondary method of treatment. 6. The peculiar, and at the time to me unexplainable, fact that in all of the cases in which no distension of the joint cavity occurred, as well as those in which the effusion having taken place, the application of a firm elastic or other bandage resulted in the rapid disappearance of the effusion, prompt and decided infection with resulting abscess of the thigh followed, in spite of every care. 7. The immunity from septic

²Annals of Anatomy and Surgery, 1885, vol. 11, p. 246.

complications in those cases in which no amount of bandaging that could be borne by the patient sufficed to prevent the occurrence of effusion within the joint; or, the effusion having occurred, led to its diminution.

I must confess that, at first sight, there would seem to be presented in the cases first cited a rather startling set-back for the operation of wiring the fractured patella, and I am willing to admit that, in the particular class of cases to which they belong, there is a positive contra-indication to the performance of the operation as a primary procedure. No surgeon, following such experiences as these, would be considered other than fool-hardy to attempt immediate suture in such cases. It therefore behooves us to critically examine the anatomical relations of parts involved in the injury where the traumatism is severe and extensive, and there seek an explanation of the untoward results just related.

The cavity of the knee-joint forms the largest synovial sac in the body. It follows the capsular investment of the joint, this latter being made up anteriorly by the quadriceps extensor tendon, the ligamentum patellæ and the patella itself. It forms a large cul-de-sac as it bulges upwards beneath the extensor tendon in front of the femur, this extending some distance beyond the line of the articular surface of the latter. Even above the point to which the cul-de-sac reaches in the thigh there frequently is found to exist a large bursa, interposed between the tendon and the bone, and which communicates directly with the cavity of the joint.

The vastus internus, together with the crureus, inasmuch as they are practically but one muscle, constitute the smaller portion of the great quadriceps extensor. It arises from nearly the entire length of the internal, anterior and external surfaces of the shaft of the femur; its attachment is only limited above by its aponeurotic connection with the lower part of the line which extends from the inner side of the neck of the femur to the linea aspera. It is also attached to the entire length of the linea aspera, at its inner side. This muscular plane, it will therefore be seen, serves as a transverse partition, so to speak, between the anterior and posterior structures of the thigh for at least three-fourths of that portion of the bone

which lies below the attachments of the capsule of the coxofemoral articulation. The lower fourth of the anterior surface of the femur is separated from that portion of the vastus internus called the crureus by the intervention of the synovial membrane of the knee-joint. It will thus be seen that the cavity of the knee-joint is really continuous in an upward direction upon the anterior surface of the femur for one-fourth of the entire length of the latter, and terminates upon the plane of the attachment of the vastus internus. The effect, therefore, of a rupture of this upper recess of the knee-joint would be to permit of the passage of serum and blood from the latter upon this muscular plane, and thence upward until the aponeurotic attachment at its upper limit is reached. At this point the extravasated fluids would find their way to and upon the glutei muscles.

With these facts before us it is not difficult to understand why suppuration of the anterior and inner portion of the thigh should occur in primary suture of the fractured patella. A sufficient explanation is to be found in the fact that there occurs an extravasation of the effused fluids, which follows immediately upon the receipt of the injury, into the spaces between the vastus internus and the bone, in those cases in which the upper recess of the joint cavity is ruptured. The opening of the knee-joint under these circumstances is almost certain to produce suppuration in a locality in which it is almost impossible to accomplish complete disinfection, by opening up a direct route of infection into the depths of the thigh along the plane of the vastus internus muscle, between this muscle and the femur. Following the course of the muscle downward, the infectious process finally reaches the patella and the wound itself, in spite of every care. The application of the dressings and bandages would tend to further the extension of this infection by forcing the effused fluids from the joint cavity through the rent in the upper recess, instead of permitting them to escape through the drainage tubes placed in the joint for that purpose. Even were the dressing omitted, the tendency would still be for the fluids effused into the joint subsequently to the operation and closure of the latter, to become extravasated into the space already invaded by the traumatism.

A striking proof of the occurrence of rupture of this upper recess of the synovial cavity, and the readiness with which effused fluids may pass beyond the limits of the joint itself and become extravasated along the muscular plane above alluded to, is occasionally seen in the rapidity with which these effusions may be made to disappear after severe injuries to the knee-joint, by the simple application of an elastic bandage. Writers have mentioned instances in which a single application of a rubber bandage has resulted in the total disappearance of the effusion in a few hours and a restoration of the normal appearance of the joint. In no other joint can this result be produced, nor yet in the knee-joint in cases in which the effusion is due to other causes; and there is no reason for believing that in this joint, pressure would hasten the resorption of the fluids in this extraordinarily rapid manner. As a matter of fact, resorption does not occur at all; what really happens is a forcing of the fluid from the cavity of the knee-joint, through a rupture of the latter at the point indicated, or elsewhere, and into the neighboring inter-muscular spaces. True, a distension of the upper recess may occur, in which no rupture has taken place, if the effusion in the cavity be not large; while the elastic bandage remains applied, the impression may be given that the effused fluids have undergone resorption. But these are not the cases in which such apparently brilliant results have been obtained, for it is found that upon removal of the rubber bandage the distension of the joint recurs. It is not to be denied that the application of the elastic bandage may be instrumental in producing resorption of the fluids both in the joint and upon the plane of the vastus internus muscle; that it occurs, however, other than by the usual and slow process, is open to doubt.

To Prof. Riedel, of Jena, we are indebted for the rational explanation of the occurrence of extensive and deep suppuration of the thigh following primary wiring in certain cases of fracture of the patella.² This observer had the misfortune to lose a patient upon the table during an attempt to suture the fragments, as a primary operation. An immediate examina-

²Centralblatt f. Chirurgie, 1890, No. xii.

tion of the parts revealed the existence of two points of perforation of the upper recess of the joint, and an extensive hæmorrhage between the vastus muscle and the bone. The impression that the first case was but a clinical curiosity was dispelled by the occurrence of a second case in the practice of the same surgeon. A male, æt. 54 years, had received a blow upon the patella by being attacked by an ox, and considerable traumatism had been inflicted. There was considerable swelling of the thigh, which, when the man was received in the hospital, eight days later, had extended to the pubis; later on, this extended upon the outer side of the thigh and to the region of the glutei. This was undoubtedly a case in which the joint capsule had been ruptured and the subsequent hæmorrhage and effusion had found their way from the parts—the site of the original injury—and had infiltrated themselves along one of the muscular planes of the thigh. In this case the hæmorrhage must have been considerable in amount, as is sometimes known to occur, as witness my own first case here cited.

A large amount of extravasation and consequent swelling of the thigh need not necessarily exist in these cases of rupture of the upper recess of the knee-joint; indeed, the surgeon's attention would scarcely be attracted by any change in the thigh itself. But a condition which should never fail to excite suspicion is to be found in the occurrence of but slight swelling and distention of the joint capsule—or, this having taken place, the fact that it has rapidly disappeared. On the other hand, the increase of pain and distension upon the application of a bandage would be an indication that the joint cavity is still intact, and other indications being favorable, the primary operation may be resorted to with comparative safety.

In exceptional instances the extravasated fluids may find their way to the popliteal space; but as the vasti have their points of origin high up, so the hæmorrhage will appear at the edge of the pelvis, for the reason that the spaces in the muscular mass are more numerous here than in the compact structures below. The discoloration of the skin, due to the hæmorrhage and extravasation, will first make its appearance upon the inner side of the thigh; later on appearing at the outer side and

upon the pelvis, and in the course of time, reaching to the leg.

Experiments to determine the amount of force required to rupture this portion of the capsule of the knee-joint had been previously made by Riedel¹. The result of these showed that 200 ccm. of fluid, under a pressure of from 3.5 to 4 metres, produced rupture of the upper recess, the limb being in the extended position. The experiments were made upon the cadavera of strong males. In a series of similar experiments by Schwartz², it was found that a pressure may be given to the fluid equal to a height of from 8 to 12 metres before rupture will occur. The discrepancy in these results is due to the fact that no account was taken of the differences existing between the cadavera of young children and aged persons upon the one hand, and those of strong individuals in middle life. In addition to this, it should be borne in mind in this connection, that the upper recess particularly is supported from without by the rigid condition of the muscles of the cadaver. In instances therefore in which rigor mortis is well marked, a resistance equal to that determined by Schwartz may be found to exist.

That this complication need necessarily be a result of the distension occurring after the fracture, is open to some doubt. There is reason for believing that it may be produced by the same violent muscular effort which is an etiological factor in the vast majority of cases of fracture of the bone.

These facts will enable us to explain the untoward results in those cases in which the symptoms pointed to the occurrence of this complication. In addition to this condition there is another positive counter-indication to the application of the suture to the fragments as an immediate method of treatment. I refer to occurrence of extensive and severe contusions in the neighborhood of the joint itself. It is a well known fact among surgeons that where structures have been the site of extensive injury, even though these may be highly organized, the lessened vitality of the part lessens its resistance to infection. The question whether such a condition as rigid and

¹Deutsche Zeitschrift f. Chirurgie, 1880, xii.

²Quoted by Riedel, *op. cit.*

absolute asepsis in an open wound really exists or not has been frequently discussed, and it is more than probable that a typically aseptic wound is of rare occurrence. The question is simply one of dosage, so far as the entrance of infectious material is concerned, and the local condition of the tissues themselves and their powers of resistance will frequently turn the scale in favor of or against the patient, rather than the efficiency of the germicides employed, or the activity of the microbes which have run the gauntlet of the antiseptic dressings. With every effort brought to bear to prevent infection, an infinitesimal portion of the morbid agent may find its way into structures which from their damaged condition may be entirely powerless to resist noxious influences; to say nothing of the fact that the increased heat, together with the presence of a greater amount of fluid within the connective tissue spaces and the opening up of these latter to a greater or less extent, undoubtedly favors, not only the primary occurrence of infection, but the rapid spread thereof. It therefore becomes a question for the surgeon to determine, in each individual case, as to whether or not he should expose his patient's tissues to even the slightest infection, in this locality, when these may not be in the best possible condition to resist the same.

This brings us naturally to the consideration of the question of the propriety of postponing the operative interference to a period when it may become one of almost positive safety to the patient. It will be scarcely claimed by even the most enthusiastic advocate of the operation of suturing the fractured patella that the procedure is urgently called for in the beginning of the treatment. With the exception of those rare cases in which arthrotomy is demanded because of the occurrence of an extreme hæmarthrosis complicating the patella injury, as happened in my first case, there is no need of undue haste in interfering. Fully a fortnight may be allowed to elapse, and even longer, with the chances altogether in favor of serving the patient's best interests by such delay, rather than adopting the opposite course and risking the life and limb of those entrusted to our care by opening up and exposing tissues whose condition is such as to suffer severely from a small dose

of infection, when on the other hand, by withholding our hand until these shall have so far recovered themselves as to resist a much larger dose. The cases above detailed in which the operation was postponed from fourteen days upward, and in which the technique of operation, as well as the surroundings of the patient, were precisely the same, so far as it was possible to make them, as those in which the operation was performed as an immediate method of treatment, when compared with the latter are strikingly suggestive of the propriety of waiting. It may be said, in answer to this, that it may be more difficult to obtain the patient's consent when the first effects of the injury have passed away, than when, in the first few hours, he is acutely suffering. That this is true I am aware, and it has occurred to me to have just this experience; but I would prefer to enjoy the consciousness of having saved the patient the risk of death or mutilation, and depend upon my powers of persuasion to induce him to submit to an operation which beyond doubt, when performed at the proper time, will give him the best possible result with the minimum of danger, than to adopt the opposite course, and rob myself of that comfort which the conviction that he has done his whole duty always brings to the surgical practitioner.